

Customized Data Acquisition System Board using LabVIEW

Rahul Sharma¹, Rohini Vaidya²

Department of Electronics and Instrumentation Engineering,
B.M.S. College of Engineering, Bangalore,
Karnataka, India

Abstract — The paper elaborates techniques to interface the custom data acquisition system (DAS) using NI LabVIEW. As the demand for DAS is increasing, newer boards are released to meet the specifications of the user. Additionally, National Instruments (NI) has provided with a powerful tool LabVIEW which is an essential component that provide solution to a wide range of engineering problems. Due to the widespread usage of LabVIEW, interfacing the custom boards will be a growing field of research. Here, the designed DAS will work at 10KSPS.

Keywords — Analog to Digital Converter (ADC), DAS, LabVIEW, Microcontroller (MCU)

I. INTRODUCTION

Data acquisition systems are being used to collect information to store or analyze some phenomenon. As the technology advances DASs are simplified and made more accurate, versatile, and reliable through electronic equipment. It is always a challenge to design a custom board and interface with most widespread tool for further processing of the data. A user using a data acquisition system (DAS) has to be provided with the ability to analyze a product that is being designed in ways which was not available a few years ago. Users performing virtually any task are using DAS systems. Few example fields of interest are Telematics, Seismology, meteorology, astronomy, robotics, bioengineering, and national defense systems.

I.1 Custom DAS

Data acquisition is process of sampling signals that measure real world physical parameter and converting the resulting samples into digital numeric values that can be manipulated by a computer. Data acquisition systems (DAS or DAQ) typically convert analog waveforms into digital values for processing. The DAS is having following features:

- 8-bit Analog to Digital Converter (ADC0804)
- Conversion times of 110 μ s
- Bipolar range of operation: 0 to +5
- Up to 10K samples per sec
- RS232 interface with 9600 baud rate

I.II Lab VIEW

LabVIEW, a system developed by National Instrument, employs a Graphical interface for signal acquisition, measurement analysis, and date presentation. The graphical interface is used in conjunction with a data acquisition board (DAQ) and a hardware workstation [1]. LabVIEW is a graphical development environment with built-in functionality for simulation, data acquisition, instrument control, measurement analysis, and data presentation. LabVIEW gives one the flexibility of a powerful programming language without the complexity of traditional development environments. LabVIEW delivers extensive acquisition, analysis, and presentation capabilities in a single environment, so one can easily develop a complete solution on the platform of your choice.

II. IMPLEMENTATION

The implementation of the paper is divided into two parts

- Custom DAS
- Interfacing with LabVIEW

II.1 Custom DAS

The block diagram for custom DAS is shown in the fig1.

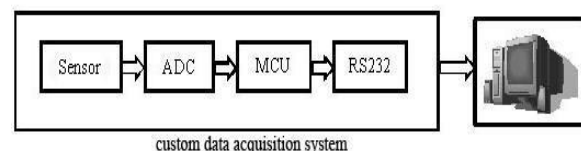


Fig 1: Block Diagram

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C). It has an output voltage that is proportional to the Celsius temperature and a scale factor of 0.01V/°C. An analog-to-digital converter (abbreviated ADC, A/D or A to D) is a device that converts a continuous quantity to a discrete time digital representation. Typically, an ADC is an electronic device that converts an input analog voltage or current to a digital number proportional to the magnitude of the voltage or current. A microcontroller (sometimes abbreviated μC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Microcontrollers are designed for embedded applications. To allow compatibility along data communication equipment made by various manufacturers, an interfacing standard called RS232 is set. It is the most widely used serial input output interfacing standard. [2]

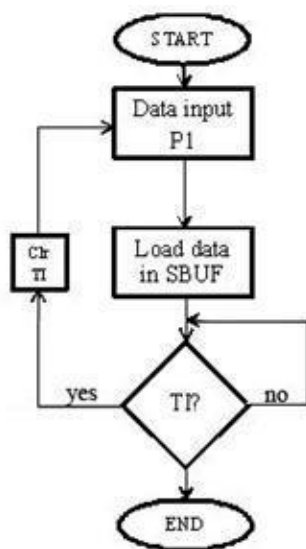


Fig 2: Flowchart for serial communication

The flow chart for serial communication is given in Fig2.

II.II Interfacing with LabVIEW

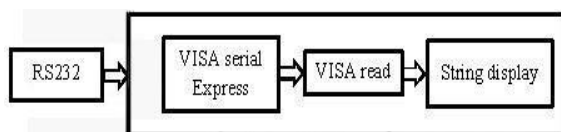


Fig 3: Serial Communication with LabVIEW

The Fig3 shows a prototype of interfacing the custom DAS. To interface with Serial Communication, LabVIEW has a supported function routine VISA Express. VISA serial express specifies the resource to be opened. Various parameters like baud rate, flow rate, data bits can be initialized. VISARead reads the specified number of bytes from the device or interface specified by VISA serial express and returns the data in read buffer. The output of VISA Read is given to display string.

The microcontroller does two operations here,

- Gets the raw data from the ADC.
- Manipulates the data to required form and average it over time.
- Sends this data serially through the COM port to LabVIEW's VISA express.

We use ADC0804 [3] to convert the analog voltage of temperature sensor LM35 to digital value. The ADC is calibrated for accuracy so is the cases with temperature sensor LM35. LM35 series are precision integrated-circuit temperature sensors. LM35 is rated to operate over a -55°C to $+150^{\circ}\text{C}$ temperature range. [4]

The MCU converts the digital input and sends it serially through the serial port P3[^]3 & P3[^]4 to the UART COM port, which then is taken by Lab VIEW through VISA express.

The sequence of steps to be follow to interface the Custom DAS is as follows,

- Configure VISA for serial communication
- Create a block diagram
- Configure all the parameters
- Run it

Configuring VISA:

LabVIEW has a powerful tool called VISA express [5] to access external components; here we use the serial COM port, with bit count 8 and 1 byte count at the read module. Basically LabVIEW has two panels. The output waveform along with the display of temperature is shown in fig5.

1. The front panel (Fig 5) is the main panel used by user.
2. Block diagram (Fig 4) is used by the programmer to program.

The communication model of command interactive mode has been widely used in microcomputer-based automatic control system. Their main function is either the boot of control command or feedback data return. For example, the communication for the LabVIEW peripheral equipment use command interactive mode for data transmission and the DAC's make use of the command set to switch information.

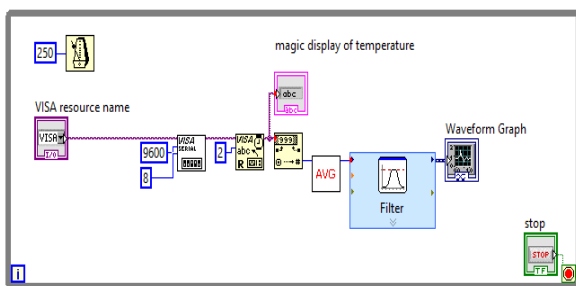


Fig 4: Block Diagram

The block diagram consists of a VISA resource name which specifies the resource to be opened. Parameters like baud rate, data bits and many others need to be initialized. The back panel also consists of a VISARead, data manipulation such as string to number conversion and averaging VI which essentially acts as a de-noising mechanism and then it passes through a low pass filter with cutoff 5 kHz (digital filter VI). The output of filter is connected to waveform graph. In the VISA Read, the byte count can be initialized. Here the baud rate is taken as 9600, number of data bits as 8 and byte count as 5. Here the program block diagram is placed inside a while loop.

III. RESULT

The front panel has a string display which is used here to display temperature. This panel consists of VISA resource name setting is pointed to computer port. Here it is set to COM1. A temperature versus time waveform graph is created in the front panel to display the output.



Fig 5: Front Panel

IV. CONCLUSION

The design procedure proposed will provide interfacing the custom data acquisition system (DAS) board using LabVIEW. The designed DAS will work at 10KSPS. This project can be extended by implementing FFT and can be made stand alone with FPGA for Re-Configurability. It can be applied to various measurement applications like temperature, pressure, humidity, etc. This finds application in automobile industry in communicating with the ECU and record the parameters analyze etc. very helpful in aviation and aerial combat industry.

V. ACKNOWLEDGEMENT

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VI. REFERENCES

- [1] Eugene Fayne, Leonard J. Mills, Patrick Ireland, Joan McGrory, and John Ventura, "LabVIEW: Instrumentation Lab and Industry", MAESC 2004, May 12, 2004
- [2] J. Machacek, J. Drapela, "Control of serial port (RS232) communication in LabVIEW", Modern Technique and Technologies, International Scientific and Practical Conference of Students, Post-graduates and Young Scientists - SPCMTT, 2008.
- [3] DS005671, National Semiconductor Corporation, November 1999.
- [4] Texas Instruments, "Handbook of LM35 Precision Centigrade Temperature Sensors".
- [5] Nation Instruments, "LabVIEW Reference Manual", USA, 2010.